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Shallow crustal structure in and around the northern focal area of the Iwate-Miyagi Nairiku Earthquake in 2008

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The Iwate-Miyagi Nairiku Earthquake in 2008 (Mj=7.2, depth=8km) occurring on June 14, 2008 in the eastern flank of the Ou backbone range, northeast Honshu, Japan is believed to be due to the inversion of normal faults forming during the spreading of Japan Sea. We modeled two dimensional shallow crustal structure in and around the northern focal area of the earthquake, mainly based on gravity survey, together with seismic reflection / refraction experiments (Abe et al., 2008; Shiraishi et al., 2009), along an E-W survey line 50 km long.
The gravity survey was conducted from October 26 to November 13, 2007, before the earthquake, with a G-type gravity meter (G497; LaCoste and Romberg Inc.). Each interval of observation sites is about 200 m. The location and elevation of observation sites were surveyed with a total station and a handheld GPS. Error of elevation is up to 0.1 m for measurement by the total station and 6 m by the handheld GPS. Acquired gravity data was processed to obtain Bouguer anomaly mostly according to the methodology of Geological Survey of Japan, AIST (200 4). We assumed that the density for Bouguer and terrain corrections were 2200 kg/m^3.
The Bougeur anomaly is at a maximum of 128 mgal in the Kitakami Mountains, the eastern part of the survey line, decreases to 60 mgal in the Isawa alluvial fan, the central part of the line, and increases to the second maximum, 100 mgal in the axial zone of the Ou Backbone Range.
Using a two-dimensional gravity field modeling software, 2MOD™. (FUGRO-LCT Inc.), which uses Talwani-type polygonal bodies to define a model, we modeled density structure along the survey line. Taking the geology and the results of the seismic reflection / refraction experiments, we assumed three layers in the model. The first layer is roughly corresponds to pre-rift rocks, the second layer (its density difference to the first layer is -400 kg/m^3) to syn-rift and post-rift formations, and the third layer (its density differences to the first layer are -800 kg/m^3) to surface formations, the P-wave velocity of which is up to 2.3 km/s.
The model leads to conclusions as follows. (1) The shallow crustal structure is characterized by four half-grabens, as was shown by Abe et al. (2008). (2) The first layer on the hanging wall of the most western fault in the area is modeled to be displaced over that on the footwall. This means that the fault, which is the source fault of the earthquake shown by Kurashimo et al. (2008), was formed as a normal fault initially during Miocene and has been reactivated as a reverse fault.

Keywords: Iwate-Miyagi Nairiku Earthquake in 2008, gravity survey, shallow crustal structure